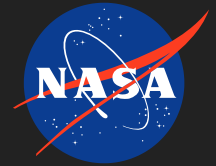


SAW passive wireless sensor-RFID tags with enhanced range, Phase I



Completed Technology Project (2009 - 2009)

Project Introduction

This proposal describes the development of passive wireless surface acoustic wave (SAW) RFID sensor-tags with enhanced range for remote monitoring of large groups of conventional sensors. Passive wireless sensing tags using SAW technology have been demonstrated by Robert Brocato at Sandia National Labs and others. These sensor-tags consist of a SAW device with an antenna attached to one port and sensor(s) and reference impedance(s) connected to the other ports. RF signals are reflected off of the surface wave device, and their reflection characteristics are modified by changes in the impedance of the attached sensor(s). This proposal describes development of novel passive wireless SAW sensor tags that combine radio frequency identification (RFID) coding with dispersive and low-loss SAW transducers and reflectors. The proposed devices utilize RFID reflective delay line coding techniques to produce devices capable of data densities over 32 bits, enabling production of large codesets. Variations in the reflected RFID code are used to identify the device and to provide a measure of the attached sensor(s), along with any internal sensing function(s). The use of dispersive low-loss transducers and reflectors provides increased processing gain and over 10 times the range of conventional SAW RFID tags. The proposed sensor devices also operate in a manner that is inherently immune to RF backscatter signals, further enhancing S/N. Successful completion of the proposed Phase I activities will establish the technical feasibility of these sensor-tags, will evaluate their performance in the laboratory when used with at least two external sensor devices, and will provide performance projections for use with other sensors. At the end of Phase I, devices will be at TRL 4. Phase II will result in development of multiple uniquely identifiable passive sensor-tags and interrogation systems operable to wirelessly monitor sensors of interest to specific NASA programs (TRL6).

Anticipated Benefits

Potential NASA Commercial Applications: Distributed wireless monitoring of sensors using passive SAW sensor-tags will have widespread non-NASA commercial applications. AE sensors have been shown to be capable of real-time detection of cracks, delamination, and other growing failure mechanisms in concrete, metal, composites, and other materials. Given the current state of the nation's aging infrastructure, this technology will be widely used to monitor the condition of bridges, tunnels, and pavements. Combination of the proposed sensor-tags with novel AE sensor technologies such as sensors based on flexible piezoelectric materials will provide low cost solutions to this extensive monitoring problem. Development of intelligent wireless infrastructure monitoring networks utilizing such passive wireless sensors combined with data correlation and interpretation would be capable of providing infrastructure owners with automated information on structural conditions, including likely causative factors for detected fault conditions. This information would be useful to the owners in effectively prioritizing limited

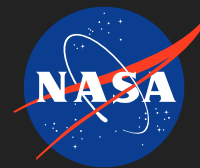


SAW passive wireless sensor-RFID tags with enhanced range, Phase I

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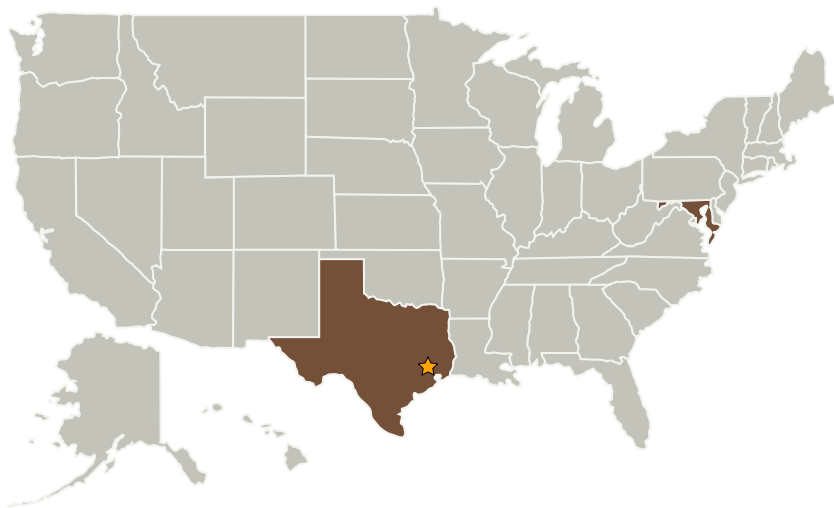
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maintenance and repair resources. Other commercial applications will likely include monitoring of commercial airframes for aging and deterioration, inventorying and tracking high value industrial assets (even in extreme environments), and distributed sensing systems for environmental applications such as landfills. ASR&D has received inquiries from potential customers related to each of these applications.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
SenSanna Incorporated (formerly Applied Sensor Research & Development)	Supporting Organization	Industry Women-Owned Small Business (WOSB), Veteran-Owned Small Business (VOSB)	Arnold, Maryland

Primary U.S. Work Locations

Maryland	Texas
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

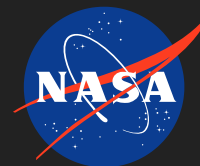
J. Fernando Figueroa

Principal Investigator:

Jacqueline Hines

SAW passive wireless sensor-RFID tags with enhanced range, Phase I

Completed Technology Project (2009 - 2009)



Project Transitions

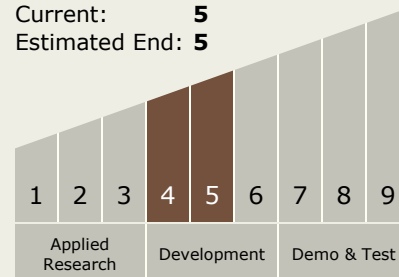
 **January 2009:** Project Start

 **July 2009:** Closed out

Closeout Summary: SAW passive wireless sensor-RFID tags with enhanced range, Phase I Project Image

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.2 Test and Qualification
 - └ TX13.2.7 Test Instruments and Sensors